core limbs 9, 10 and 11 and the retaining yokes 12 and 13. In the embodiment shown, both the core limb and the yokes have a tapering cross section. A power transformer according to the invention may also be formed without of the core, i.e., the transformer may have a so-called air wound winding.

IN THE CLAIMS:

Please cancel claims 34 and 35 without prejudice.

Please amend the claims as follows:

36. (Amended) The machine of claim 27, wherein the winding is operable free of partial discharge.

REMARKS

This Amendment is in response to the Office Action of February 24, 2001 in which the Examiner objected to the specification and claims. The Examiner rejected claims 1-6, 9-11, 13-15 and 17-39 as unpatentable over Grimes et al. in view of Elton '565. Claim 8 is rejected as above and further in view of Takaoka et al.

The Examiner's various objections are addressed hereinafter.

With respect to the description of the flexible cable, the cable structure is described in the specification and illustrated in Figs. 2 and 3. In accordance with the specification, the strands forming the conductor are insulated from each other. *See, for example,* page 17, lines 24 and 25, in which it is noted that the

strands may be varnished to provide insulation. At the same time, at least one strand is uninsulated so as to make contact with the inner semiconducting layer to thereby establish the equipotential surface. It should be noted that each of the strands is operating at essentially the same high voltage potential. The purpose of the inter-strand insulation is to prevent eddy currents. The insulation for the strands is not for the purpose of confining the electric field. This function is achieved by means of the three-layer structure surrounding the conductor. As noted in the specification, the electric field is confined within the winding and there is no electric field outside the outer semiconducting layer. Page 18, line10-12. Thus, the traditional means to control the field are not required because the field is confined within the insulated covering of the cable. The specification has been amended in order to incorporate the language of claim 16 as originally filed therein. According to the disclosure, the transformer winding may be fabricated without a core. Claims 34 and 35 have been cancelled without prejudice. With respect to claim 34, although the term "rated voltage" is described in the specification, which term is a measure of overload, the claims is believed to be unnecessary as the features of the invention are otherwise covered.

With respect to claim 35, end windings are, technically, more related with rotating machines. Hence, the claim is cancelled.

The Examiner has objected to the term "substantially" in claims 5, 31 and 33. It is believed that the term is not relative but simply recites that the standard is such that defects and cracks or the like do not arise in the boundary layer between the semiconducting layers. In addition, the structure and composition of

the various layers is disclosed in the specification and one of ordinary skill in the art could readily ascertain what is meant by the term "substantially."

With respect to claim 36, the term "field control" has been deleted. However, the term "partial discharge" has been retained as it is believed described in the specification. An object of the invention is to reduce partial discharge and, indeed, this is achieved by confining the electric field within the insulated covering of the cable. Thus, the term is believed to be fully disclosed and supported by the specification so that one of ordinary skill in the art would be able to appreciate the invention and reproduce the same.

The Examiner has rejected the claims over Grimes in view of Elton ('565). According to the Examiner, Grimes allegedly discloses the instant claimed invention except for the specific cable used for the windings. The Examiner asserts that Elton discloses the electric cable for use with electric devices and thus it would be obvious to combine Elton's cable with the structure of Grimes. Takaoka is cited for use of a voltage cable having a specific size range.

The Examiner's rejection of the claims is respectfully traversed for the reasons set forth below.

It is respectfully submitted that Grimes does not disclose the claimed instant invention except for the specific cable used for the windings. Grimes is a low voltage conventional transformer. By low voltage is meant on the order of 10 kV. The present invention is designed for much higher voltages, but more importantly, the present invention is designed for operation without additional insulation outside the winding. Indeed, the arrangement of Grimes is specifically

designed for operation within an insulated liquid which provides cooling and insulation outside of the winding.

In addition, the arrangement of Grimes uses a strip conductor 18 upon which insulation has been deposited. However, the spacers or duct sticks 24 are interposed between the adjacent layers for the purpose of establishing an air insulation layer and for providing cooling ducts between the strip conductors. In Grimes, the electric field exists outside the winding and it must be immersed in an insulating liquid in order to properly insulate the device. In the present invention, insulation outside the winding is not required and a cooling liquid is not required.

One of ordinary skill in the art would not employ the arrangement of Elton for equalizing electrical potential and minimizing corona discharge because there is no motivation to make the substitution. For example, why would one put the arrangement of Elton in an oil insulated and cooled transformer? Further, the arrangement of Grimes employs duct sticks to separate and provide cooling channels between the insulators and to provide an insulated air space around the winding, which the present invention does not require.

The Elton reference employs an impregnated glass fiber tape around a power cable. One of ordinary skill in the art would not substitute a power cable for a strip winding in an oil insulated and cooled transformer.

The arrangement in Grimes is not a high voltage system. The term "high voltage" has a special meaning depending upon the application. In transmission and distribution, a high voltage may be at or near the grid voltage which can be

over 100 kV. In power transformers and the like, a high voltage may be in the 10 kV range. If it is intended that a transformer be connected to the grid on the high voltage side, conventional arrangements require special insulating systems including liquid filled chambers. The present invention can operate without a liquid filled chamber and without spacers between the windings.

Elton is directed to a use of a pyrolyzed glass fiber layer in a variety of applications. For example, Elton describes surrounding conventional bar-type windings of an electric machine with a layer of pyrolyzed glass fiber in electrical contact with ground to minimize corona discharge by providing a path to ground to bleed off built up charges. Elton also describes using a semiconducting pyrolyzed glass fiber layer to equalize the potential on the exterior of the insulator of a power cable. Elton describes yet another application of the pyrolyzed glass fiber layer as a way to protect electronic components by coating the exterior surface of a housing with the semiconducting pyrolyzed glass fiber engine.

However, Elton does not teach or suggest that the cable shown in Figure 7 could be used as a winding in a transformer. On the other hand, the cable in Elton is but one of several exemplary applications of the pyrolyzed glass fiber layer described in Elton. There is nothing in Elton to suggest a desirability of using the cable shown in Figure 7 of Elton as a winding in a transformer.

The outstanding Office Action asserts the motivation for combining Grimes and Elton would be "for the purpose of equalizing the electric potential and minimize corona discharge." However, there is nothing in Grimes to indicate a desirability for a winding having different properties than the strip winding

disclosed therein. Moreover, Grimes is inherently designed for operation at relatively low voltages. Accordingly, there is nothing in Grimes to suggest a motivation to change the windings, or anything to suggest that it is feasible to operate with cable windings that operate at high voltage.

Elton recognizes that in the end-winding region just outside of the stator of an electric machine, there will be problems caused by strong electric fields. As a solution, Elton describes using a known grading near the stator to allow some of the accumulated charge to bleed off to the stator, thus reducing the risk of arcing. Elton offers only conventional solutions to the problems in the end-winding region. The strong electric fields will be present throughout the end-winding region, not just near the stator. The grading used in Elton will help to lessen the effects of the strong electric fields near the stator, but does not address the problems in the end-winding region away from the stator. Elton uses rigid bar-type windings which are able to withstand mechanical stresses caused by induced fields between the windings in the end-winding region, where electromagnetic fields are not contained in the winding. The mechanical rigidity of the bar-type windings suppress the amount of vibration in the end-winding region that would otherwise be present. The fact that a grading system is used to lessen the end-winding region problems near the stator in Elton is further evidence that Elton does not suggest using the cable of Figure 7 as a winding of a machine, since such a cable would not have a grading. These are useful features for rotating machines. They have no bearing on problems associated with transformer design.

The "invention" in Elton is the pyrolyzed glass fiber layer. Elton describes a process of immersing the winding portions in a bath of resin and vacuum pressure impregnating (VPI) the resin in the winding. The VPI process results in a cured resin having no voids or gaps between layers. The cured resin is a hard material, which is an important observation, since it would be difficult, if not impossible, to make a winding with a stiff cable as described in Elton.

For a proper obviousness rejection based on combination of references, there must be evidence in the references themselves showing that there was a motivation to combine the references, or from what was known to one of ordinary skill in the art, not merely that it was feasible to combine the references. It is respectfully submitted that there is no evidence (1) of a desirability to modify the winding used in Grimes, (2) to suggest that the cable described in Elton could be used as a winding in a transformer, or (3) that one of ordinary skill in the transformer art would have a reasonable expectation of success if the transformer in Grimes was modified to operate with cable windings that operate at high voltage.

Applicants assert that the Examiner has made an improper combination of references in light of the standard regarding such a combination, set forth in In re Geiger, 815 F.2d at 688, 2 USPQ2d at 1278 (Fed. Cir. 1987). This standard is that "[o]bviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination." Id. (emphasis added). As will be shown, the art fails to teach the combination.

The Examiner states that it would be obvious to use the high voltage cable taught by Elton as winding conductors since the modification, according to Elton, allegedly would equalize electrical potential and minimize partial discharge . While Applicants recognize that Elton appears to disclose a problem with corona discharge in the art of dynemoelectric machines, the apparent advantage of reduced corona discharge cannot be achieved in a transformer by using the teachings of cable 100 of Elton.

As an initial matter, the portion of the teaching of Elton relating to cable 100 is for electrical power transmission and distribution, not for use as a winding. There is no teaching of cable 100 as a winding, and therefore, there would be no motivation provided by the reference itself to use it as a winding in other contexts as contended. As background, Elton disclose, generally, a semi-conducting layer for insulated electrical conductors in three different embodiments. The first embodiment (Figures 1-6) deals with conventional bar type windings in a dynamoelectric machine. In this embodiment, the conductors are referred to exclusively as "windings" or "bars". The second embodiment (Figure 7) relates strictly to an electrical cable used for the transmission of high voltage. Within this embodiment, the conductor is referred to as a "cable" and not as a "bar" or "winding". The third embodiment (Figure 8) relates to the use of a semiconductor layer disposed on an electrical housing surrounding digital electrical equipment. The conductor in this particular embodiment is referred to as a "housing" as opposed to a "cable," a "bar," or a "winding.' In reviewing the Elton. reference,

the terms used were carefully chosen and applied uniformly throughout the reference.

It is a substantial omission that there is no mention of cable 100 being useful as a winding in a transformer. Had the patentees believed that an embodiment comprising cable 100 as a winding would work in a transformer, it is respectfully contended that they would have at least disclosed such a use. Applicants contend it can be reasonably inferred that the patentees did not do so because they believed, as would others in the art, that it would not work. The meticulous use and choice of words supports this position. The Examiner has not set forth any reasons to the contrary, other than the alleged advantage of reduced corona discharge. As discussed below, this advantage does not apply to the combination suggested by the Examiner.

Moreover, Applicants further submit that there is no incentive to combine these two references because the advantage of reduced corona discharge can only be obtained by following the teachings of Elton, which, for a dynamoelectric machine, means use of a rigid "bar" with one layer of semiconductor material, not an electrical transmission and distribution cable. Indeed, strip conductors are not "bar" conductors and cable conductors are neither strip conductors or bar conductors. Therefore, there is no incentive to combine, as contended by the Examiner, when the advantage does not actually materialize.

Furthermore, Applicants note that the MPEP §706.02(j) states that one criterion that must be met to establish obviousness is that there must be a

reasonable expectation of success. This criterion cannot be met when the aforementioned references are combined.

There is no likelihood of success in modifying the winding of Grimes with cable 100 of Elton because of the brittleness of cable 100. In particular, that cable includes a pyrolyzed glass fiber layer which would crack at the corners where the bend in the windings is severe, resulting in, not prohibiting, discharge when attempting to wind it around a core, not only negating the apparent advantage of prohibiting corona discharge, but resulting in a combination that fails to work at all.

Further, Grimes provides a mechanism for cooling (i.e., ducts 22). What would motivate one of ordinary skill in the art to substitute the cooling approach so carefully described in Grimes with an untested air cooled arrangement of the invention where one of the primary features of Grimes (liquid cooling) is sacrificed for a problematic improvement in corona discharge resistance? The Examiner contends the resultant combination would equalize electrical potential and minimize corona discharge. However, there is no evidence that Elton's system is more efficient or would otherwise improve Grimes. Applicants do not agree that the Examiner's conclusions follow from the references. Only in Applicants' own disclosure is the claimed invention found. Applicants contend this line of reasoning amounts to impermissible hindsight reconstruction.

Applicants submit that the series of logical steps required to be made in order to combine the references are simply not taught nor suggested in the

references, and that it would not have been obvious to one skilled in the art to make the stated modifications in light of Grimes and Elton et al.

Accordingly, Applicants respectfully submit that base claims 1, 24 and 27 define novel and non-obvious subject matter. Applicants further respectfully request that the rejection be reconsidered and withdrawn.

Dependent claims 2-6, 9-11, 13-15, 17-23, 25, 26, 28-33 and 36-39 include all of the limitations of their corresponding base claims and therefore, for at least the same reasons set forth above, the rejection of such claims is improper. Applicants respectfully request that these rejections be reconsidered and withdrawn.

Claim 8 is rejected under 35 U. S. C. § 103(a), as above, and further in view of Takaoka et al. The Examiner contends that it would have been obvious to have used a conductive area between 30 and 3000 mm^2 and an outer cable diameter between 20 and 2550 mm as shown by Takaoka.

Takaoka discloses a conductor having insulated and uninsulated strands. The purpose of the feature in the reference is to reduce the "skin effect" associated with self induced currents in a transmission and distribution cable. It has nothing to do with reducing eddy currents in the winding of a transformer. In the present invention, the insulated strands reduce eddy current losses by restricting the paths for such currents between the conductive strands. However, according to the invention, it is necessary to employ at least one un-insulated strand to make contact with the semiconducting layer in order set up an equipotential field. In Takaoka, the outer strands are insulated because that is

where the skin effect current flows. Accordingly, the reference teaches away from the invention because in the invention the outer strands are un-insulated for a different purpose.

Furthermore, Applicants respectfully assert that Takaoka is simply a conventional device, which does not employ a high voltage cable as a winding. Takaoka may disclose a conductor having insulated and uninsulated strands; however, the purpose of this feature in Takaoka is to reduce the "skin effect" associated with self induced currents in a transmission and distribution cable. It appears as if the Examiner recognizes that Takaoka is a transmission and distribution cable because he contends that Takaoka teaches that it would be obvious to modify the cable of Grimes in view of Elton and with Takaoka to incur power handling capacity. First, Grimes does not employ a cable. Second, Takaoka has nothing to do with a cable winding where power is generated, much less reducing eddy currents which develop when the cable is used as a winding of an electromagnetic device.

In the present invention, the insulated strands reduce eddy current losses by restricting the paths for such currents between the conductive strands. Eddy currents are induced in the winding as a result of the exposure of the winding to high magnetic fields in the transformer. These currents are problematic in these applications because they create electrical losses which are manifested as thermal energy (heat). Transmission and distribution cables are not subjected to the localized high magnetic field.

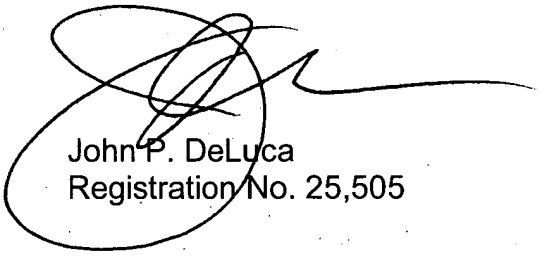
It is also necessary to employ at least one uninsulated strand in the instant invention to make contact with the semiconductive layer to set up an equipotential field, thereby confining the electric field within the winding and allowing for its use as a high voltage winding. In Takaoka, the outer strands are insulated because that is where the skin effect current flows. Accordingly, Takaoka teach away from the invention (as claimed) because in the invention, the outer strand or strands are uninsulated for a different purpose. Therefore, in view of the foregoing, Applicants contend that one of ordinary skill in the art to which the invention pertains would not look to Takaoka. The reference does not disclose a cable as a transformer winding, and the cable therein is not employed in high voltage applications.

Applicants plan to supplement this Amendment by submission of a Declaration by Ken Linsley, an expert in the area of transformer design. Mr. Linsley's Declaration will assert that it would not be obvious to a transformer expert to employ the cable of Elton in the transformer of Grimes, nor would it be obvious to employ the features of Takaoka as well.

Applicants also plan to supplement this Amendment by submission of a Declaration of Torben Aabo, an expert in the area of cable manufacture and design. Mr. Aabo asserts that the cable of Elton is suitable for power distribution and transmission, and not as a machine winding.

In view of the foregoing, it is respectfully requested that the Examiner reconsider his rejection of the claims, the allowance of which is earnestly solicited.

Respectfully submitted,



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VERSION SHOWING CHANGES TO CLAIMS

IN THE SPECIFICATION:

The paragraph bridging pages 20 and 21, as amended:

The windings of the power transformer/reactor manufactured from the cable described from the summary of the invention may be used both for single-phase, three-phase and poly-phase transformers/reactors independently of how the core is shaped. One embodiment is shown in Figure 3 which shows a three-phase laminated core transformer. The core comprises, in conventional manner, three core limbs 9, 10 and 11 and the retaining yokes 12 and 13. In the embodiment shown, both the core limb and the yokes have a tapering cross section. A power transformer according to the invention may also be formed without of the core, i.e., the transformer may have a so-called air wound winding.

IN THE CLAIMS:

36. (Amended) The machine of claim 27, wherein the winding is operable free of partial discharge [and field control].